VII.—ON A REMARKABLE SODALITE TRACHYTE LATELY DISCOVERED
IN NAPLES, ITALY.

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IN the last two British Association Reports of the Vesuvian Committee, I drew attention to some very large masses of trachyte traversed, at the back of Naples, by the tunnel of the Cumana Railway. A full account of the stratigraphy of these will be deferred until some further excavations, now in progress, are completed. I propose at present merely to describe the earliest-discovered and most striking of these masses.

This trachyte is cut through on the E.N.E. side, at 1890 metres from the terminus end of the tunnel at Monte Santo, in a slightly oblique manner, which traverses it for 1980 metres on the southern side, and 2000 on the northern. Thus, it will be seen that the tunnel forms the chord of an arc, the circumference or boundary-line of the trachyte being directed southerly, or towards the present sea-coast. Both contacts are old escarpments, and at the W.S.W. end a talus is cut through of fragments of the trachyte and other materials, on which is superposed a series of pumice, ash, lapilli and vegetable soil-beds, representing many successive eruptions; the latter are also met with at the opposite escarpment, placed at a high angle of rest. We thus see that this mass was no doubt erupted as a subaerial lava-stream, probably cut back by the sea, or other denuding agents, to a vertical cliff, and subsequently covered by the different tuffs that constitute the hills above.

The rock is divided into rather large blocks by irregular cooling cracks, very similar to the Mont Olibano trachyte, which it most resembles in general characters. It is of light grey colour, with a somewhat bluish tint and earthy fracture, is harsh to the touch, adheres slightly to the tongue, and a drop of water falling on its surface is immediately absorbed. These latter characters are probably dependent upon actual spaces between the crystals and microliths, whilst the colour can be seen to be due to the admixture of glassy felspar with numerous minute dark particles. The sanidine crystals are mostly very thin, tabular in form, and show sections up to nearly two centimetres in length, in which Carlsbad twinning can be seen. A few rare but large individuals are compacter in shape, and prism-like, resembling those of the Drachenfels trachyte. Microscopically they are much fractured and fissured, very clear, with a few glass cavities, whilst in each fractured fragment much internal strain is evidenced by the ring of colours just within its outline. The sanidine is decidedly the most important constituent of the rock, and next to it we have the amphibole, which exists in two or three varieties. One is usually in larger crystals, attaining a maximum measurement of two or three millimetres or more, and commonly occurring as irregular crystalline grains, with sharp edges, as if fractured shortly before consolidation in consequence of the internal friction of the semi-solidified pasty mass. Some sections exhibited typical cleavage. The colour of this variety is yellowish

or greenish brown, and comparatively slightly pleochroic. The smaller crystals are also very irregular in shape, and range down in size to large microliths. Even when a comparatively well-formed rod is examined, no extinction can be obtained, the whole undergoing aggregate polarization, as if some molecular change had taken place, or as if each individual were constructed of an association of minute grains. By changes that have occurred in much larger crystals of extraneous enclosed masses, it would appear that these microliths and crystals really consist of a mixture of pyroxene and amphibole. Another fact is that the greatest darkening is obtained at two points in rotating through 90° between crossed Nicols corresponding with the extinction of these two mineral species. The other variety of amphibole is certainly more recent in formation, but seems to have undergone the same molecular change, for it is almost impossible to get any definite extinction. The crystals are well formed, and associated with cavities, and no doubt are the same as those that project as long rods from the sides of the vesicles of this rock. In colour, they are very dark bluish-green, faintly pleochroic, but their opacity prevents a just estimation of such.

The ground-mass consists principally of sanidine microliths of large size in fact, so large that in many cases Carlsbad twinning can be made out. Interspersed amongst these felspar microliths, and those of amphibole already mentioned, are numerous grains of magnetite, which apparently have crystallized mostly as octahedra, their form being partly obliterated by a rusty iron stain surrounding them. Rarely, highly refracting colourless grains occur of uncertain character, and within some felspars long four-sided orthorhombic? prisms with domes, of a fibrous-looking mineral, occur, which in some sections looks much like a triclinic felspar in structure. Some attempts were made to isolate one of these, but unsuccessfully, and, on account of their rarity, none other suitable examples could be met with.

Some parts of this mass of trachyte are vesicular, though the cavities are not very close together. There are also a certain number of fissures formed before the rock had quite consolidated. These vesicles and fissure-spaces are lined by a number of minerals which constitute the beauty and striking characteristic of this trachyte. Projecting from the walls of these spaces, long pseudo-hexagonal prisms, sometimes solid, at others tubular, occur; in the former case they are usually colourless, and as limpid as cut glass. In size they range up to and beyond one centimetre long, and from one to four millimetres broad. They may be traced by gradations to fine well-formed dodecahedra of sodalite, which are somewhat white or milky in colour. Associated with these sodalites are numerous rods of black amphibole, thin and long, usually about a millimetre broad and from a half to one centimetre and a half in length. Much rarer and irregular hollow-faced crystals of a black colour, with usually a rough submetallic lustre, which is commonly steel-black, but may be of dark bronze colour; most of these crystals are imperfect, and frequently arranged in chains. As far as I could make out, they

have much the form of a pyroxene with the faces 110, 100, 112 and 111 well developed. A few were sliced, and show under the microscope a yellowish-green mineral, changed on the surface and along the cracks to a dark almost opaque brown mass. Unfortunately no very characteristic cleavage or extinction angles could be obtained. A grain reduced to powder and fluxed with carbonate of soda gave a strong manganese reaction. These facts would seem to indicate that we have pyroxene crystals which are undergoing decomposition, either from the separation of an oxide or hydrated oxide of manganese, or the introduction of this from without. The former I take to be the correct explanation, since the brown stains only occur on these crystals and in their immediate neighbourhood, and also the amphibole rods are unaltered except where in contact with these pyroxene crystals.

In some of the vesicles are bunches of hair-like crystals of chocolate colour, which at first sight look like breislakite. Examined under the microscope they are seen as absolutely opaque rods, even to the smallest dimensions. Although easily visible as large sprays, the actual amount of material is very small, so that I was unable to obtain more than two or three milligrammes. Part of this was treated by the four acids, but proved very slightly soluble in HCl and HF.

The HCl solution gave a blue precipitate with K_3CyFe_6 . Another portion was fluxed with alkaline carbonates and proved very refractory, lixiviated with subsequent addition of HCl evaporated to dryness, then, dilute HCl added and filtered. The filtrate gave strong iron reactions, whilst the filter was burnt, and the ashes treated with HF and H_2Go_4 evaporated and fluxed with PotBisulphate and a HCl solution made which gave faintly the reaction for titanium. With salt of phosphorus in reducing flame it gave a blood-red bead. From these reactions we may conclude that we have to deal with a compound containing principally titanium and iron, and the question remains open whether we have to deal with a fibrous hematite containing titanium (Scacchi has proved the fibrous mineral in the piperno to be an iron-oxide), or a fibrous rutile very rich in iron, or lastly perhaps a breislakite containing titanium.

Most of the cavities are completely lined by a carpet of minute sanidine crystals; but superposed on these, in a few, are small elongated hexagonal-looking prisms which rarely attain to more than half a millimetre in length and about a sixth in breadth.¹ Under the microscope they are larger in the centre, so as to appear fusiform, whilst the surfaces of the prism are striated longitudinally, so that in only a few cases can they be made out to be hexagonal. The prism is terminated sometimes by basal planes, but in others by a low pyramid.

Various attempts were made to measure the angle between the pyramid and prism, and most often with a resulting angle of 116° ,

¹ Often poised delicately on the amphibole rods, or the fibres of the breislakite-like mineral.

but in some cases as much as 125° was obtained. Under high powers a large number of minute well-formed cubes about 0.02 millim. are observable attached all over the surface of these hexagonal crystals. What either of these minerals may be is a difficult matter to decide, but the striking resemblance of the hexagonal one and its analogous mode of occurrence would easily lead one to refer it to microsommite. Lastly, but rarely to be met with, are minute acicular orange yellow crystals that look at first sight like small titanites (semeline). In HCl, however, these dissolve with much effervescence, and the solution gives an abundant precipitate with ammoniac oxalate, and, therefore, may be referred to scalenohedra of calcite.

The order of crystallization in the cavities seems to have been as follows:—

1, Sanidine; 2, Amphibole; 3, Pyroxene; 4, Rutile?; 5, Sodalite; 6, Microsommite?; 7, Calcite.

Strangely enough I have not been able to find a trace of mica, either in the matrix or in the vesicles. I am the more struck with this, since in some blocks of a very similar rock near Pianura, enclosed in the cavities with the amphibole are most beautiful large brown plates of biotite.

The minerals are no doubt sublimates, or more properly result from the reaction of different vapours under special conditions of temperature and pressure.

A bulk analysis of this rock was made with special precautions as to sampling and the avoidance of regions in which vesicles occurred. The results are given below:—

Si	O ₂	...	...	57.909
Ti	O ₂	...	...	0.654
Al ₂	O ₃	...	...	15.786
Fe ₂	O ₃	...	...	6.807
Fe	O	...	...	0.010
Mn	O	...	...	0.230
Ca	O	...	...	2.986
Mg	O	...	...	1.656
Na ₂	O	...	...	6.013
K ₂	O	...	...	7.270
P ₂	O ₅	...	...	0.007
Cl		...	...	0.606
H ₂	O	...	...	0.336
				100.270
Sp. Gr.				= 2.516

This analysis gives the composition of a trachyte somewhat similar to that of Scarrupata. The uncommon point is the high percentage of titanitic acid.

What is remarkable is the very fresh appearance of this rock, whilst the minerals of the vesicles seem hardly to be altered, yet the bisilicates in the base are in a state of molecular instability, so that some doubt exists as to whether these changes are pre- or post-eruptive. The great interest of this trachyte will be its relationship to two other masses lately met with in its neighbourhood.